PERSONAL SOUND ARCHITECTURE

ANALOG DEVICES

MORE THAN A CHIPSET... A WHOLE NEW MINDSET

The Personal Sound Architecture™ (PSA™) redefines the paradigm for personal computer sound integration. This programmable architecture delivers software-based technologies for sound cards such as music synthesis, audio compression, and spatial effects in the form of bundled or shrink-wrap software.

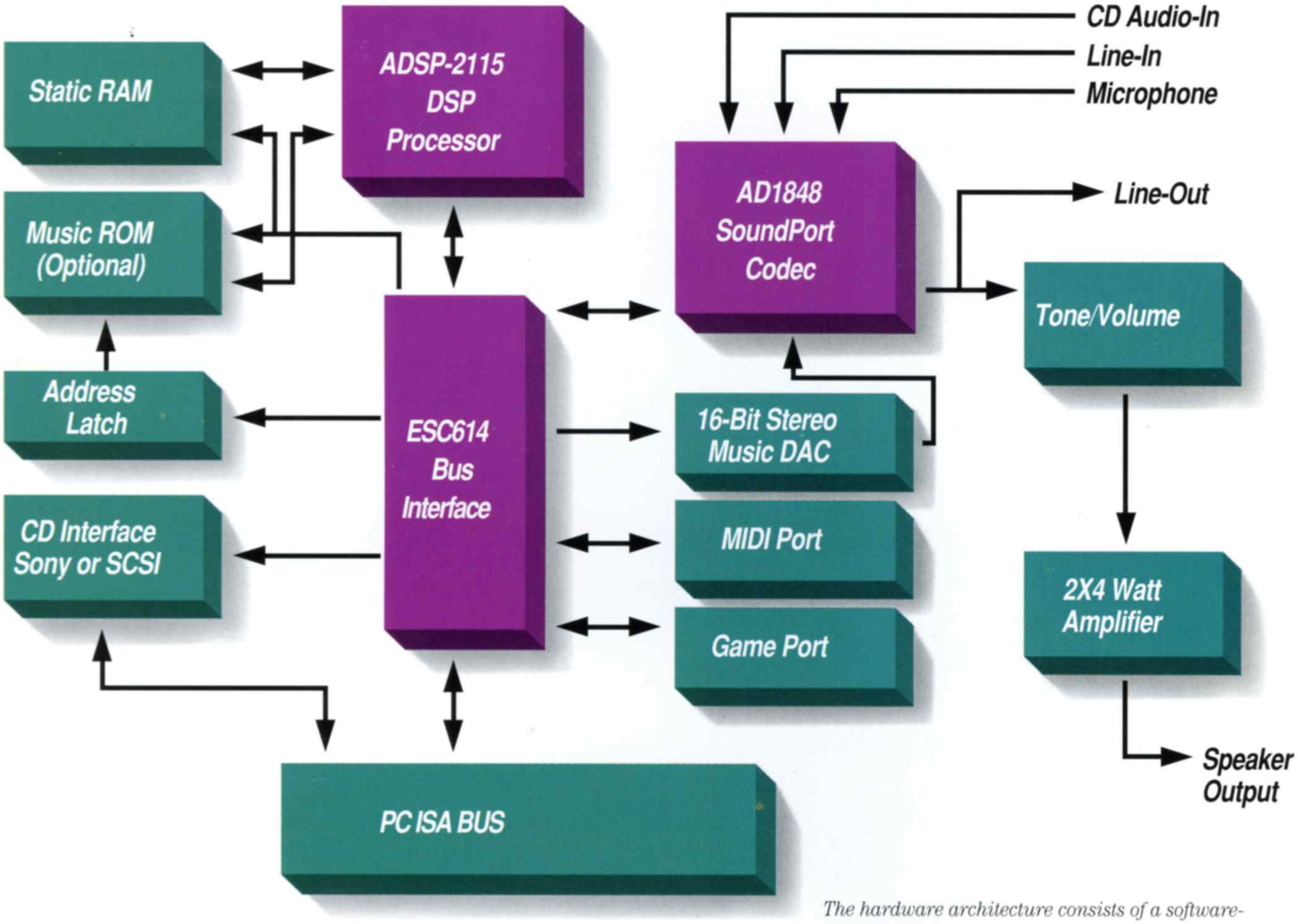
The PSA carries no premium for this flexible, software-based solution set over traditional sound card designs. Total BOM cost structures range from $65 to $90 for high-volume ISA cards depending on CD-ROM, memory, and Joystick port options. This includes Analog Devices' chipset and all discrete components, PCB, brackets and headers, and baseline software licenses.

PSA-based products boast application compatibility with the industry's broad range of PC sound standards. Register-level Sound Blaster® emulation delivers backward compatibility with the large installed base of games running under native DOS — no tricks!

The architecture also maintains forward compatibility with Microsoft's Windows Sound System™ standard thanks to Analog Devices' AD1848 SoundPort® codec. This stereo 16-bit sound I/O device forms the heart of Compaq's Business Audio initiative, and provides application compatibility with the sound standard in mainstream business computing.

For the more refined listener, the PSA supports General MIDI wavetable synthesis through an MPU-401™-compatible bus interface. Software licenses for wavetable upgrades cost just a few dollars in high-volume OEM quantities including the 512K wavetable ROM. This crashes the historical price point for musical instrument capabilities.

> *"The PSA redefines the paradigm for personal computer sound integration. It offers unparalleled flexibility as well as major growth and profit potential to all major players in the industry."*
>
> *John Donovan*
> *Director, Workgroup Technologies*



The hardware architecture consists of a software-programmable digital signal processor, the industry-standard AD1848 SoundPort codec, and multi-standard ISA bus interface ASIC. The PSA design guideline also supports a ROM-based music look-up table and industry-standard audio input/output configurations.

The PSA supports all major sound application standards for game cards, business audio, and multimedia.

"The PSA is a stable, well-engineered design capable of delivering high-quality sound for PCs. During our extensive testing we found it to be virtually 100% compatible with every genre of sound application, including Sound Blaster, MPC, Windows, and MIDI."

Tom Benford, President & CEO
Computer Product Testing Services

The AD20msp614 chipset delivers low cost for mainstream PC channels and supports limitless feature differentiation in software.

"We are excited to see the evolution of the Personal Sound Architecture, and we are pleased that it maintains full compatibility with the Windows Sound System standard."

Blake Irving
OEM Marketing Manager, Microsoft

Manufacturing kits from third-party integrators provide turn-key application, algorithm and driver bundles, and comprehensive user documentation.

Standards Compatibility

Sound Blaster Emulation under Native DOS
Windows Sound System
General MIDI Music Synthesizer
Multimedia PC (MPC®)

Reference Hardware Features

Component BOM Cost under $70 (100K Volume)
High-Performance ADSP-2115 16-Bit Digital Signal Processor
Industry-Standard AD1848 SoundPort® Codec
Stereo Line-In and Line-Out Ports
On-Board 4-Watt/Channel Stereo Speaker Amplifier
Programmable Tone and Volume Control
Sony® CDU-31A CD-ROM Interface
MIDI/Joystick Port
Optional Music ROM

Algorithm Software Features/Upgrades

- Industry-Standard Music Synthesis
  - OPL-2/3 FM-Compatible Emulation
  - General MIDI Wavetable Music Synthesis
  - QSound Spatial Enhancement
- Speech Coding at up to 36:1 Compression
  - Industry-Standard IMA-ADPCM, MS-ADPCM
  - Real-Time GSM, CELP, Echo® SC-1
- Robust Speech Recognition and Synthesis
  - Neural Network Recognition for Noise Immunity
  - Word Spotting for Command and Control
  - Large Vocabulary for Automated Dictation
- High-Fidelity Audio Compression
  - MPEG Layer II Audio Decode
  - Dolby AC-2 Compression / Decompression

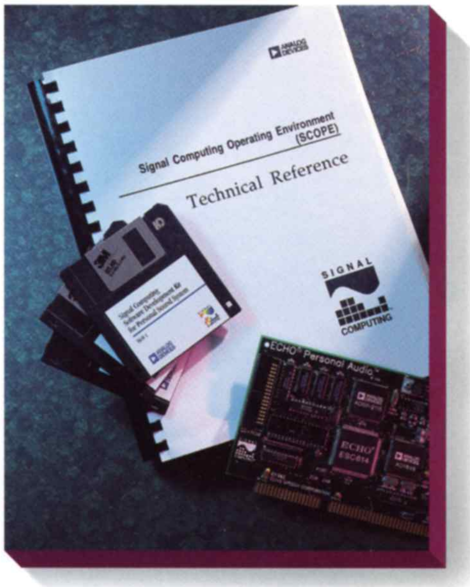
THIRD PARTY PROGRAM

The PSA offers tremendous diversity in software technologies and products. With its open system architecture, Analog Devices has evolved highly successful third-party developer programs. These programs have supported the creation of the most diverse algorithm, applications and integrated-solutions offering within today's Signal Computing market.

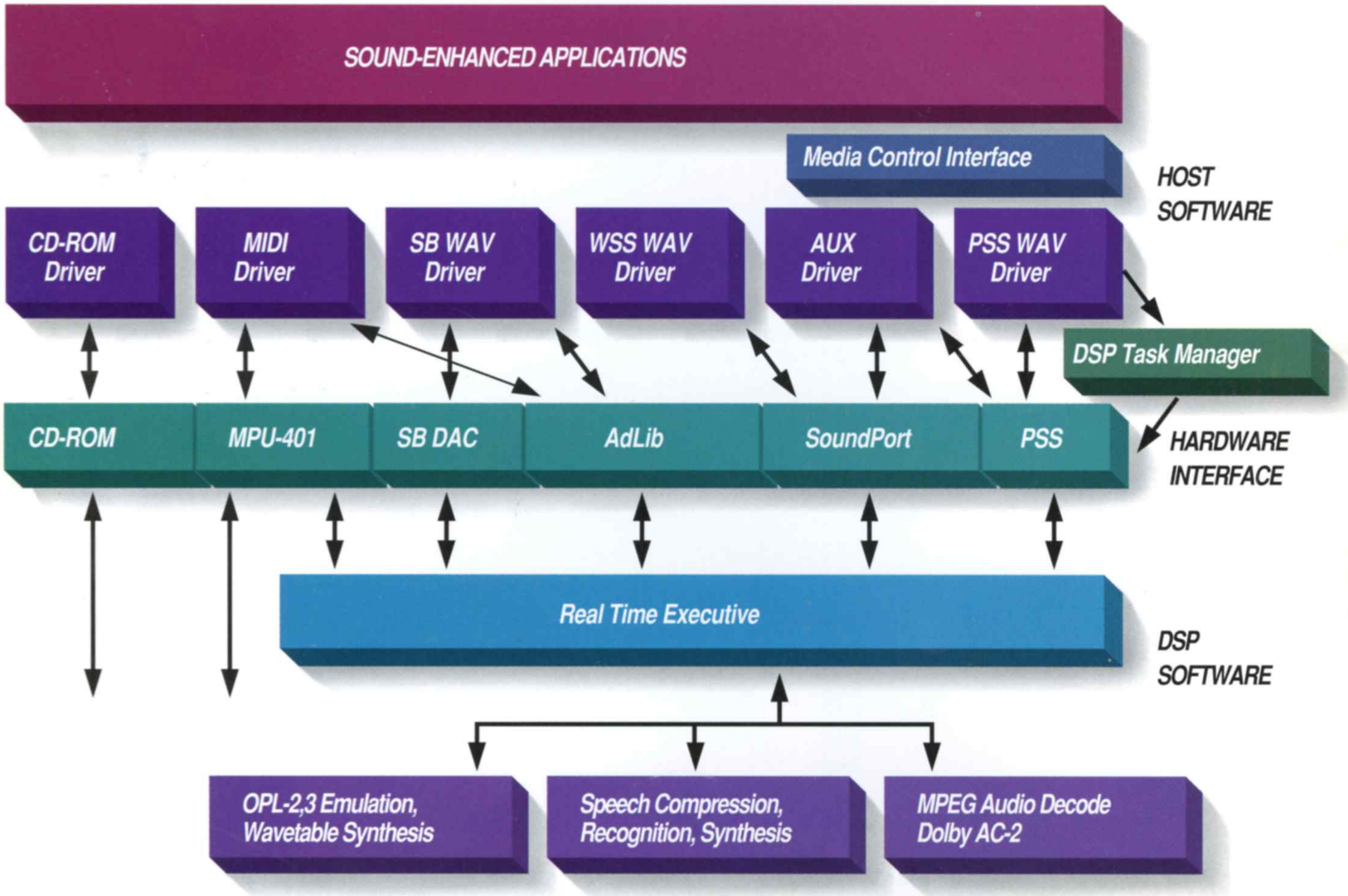
Analog Devices supports independent developers' efforts with an array of free technical services including: access to worldwide Signal Computing developer centers; technical exchange conferences; software developer kits; special developer pricing on hardware and software development tools; and beta site product participation.

Additionally, Analog Devices promotes third-party developer sales by its endorsement of the Signal Computing integrator sales channel. Third-party integrators offer a variety of technical services to the OEM. Services include hardware designs and customization of the algorithm and software solutions from different developers into one fully tested solution set and bundle license. The integrator provides OEMs with "one stop shopping" for Signal Computing solutions.

> *"We have been pleased with the success of Compaq's Business Audio which is a standard feature on our entire DESKPRO line, and is based on the Analog Devices AD1848 audio codec. We are encouraged by Analog's commitment to advancing PC audio technology."*
>
> *Andrew Watson*
> *Director, Desktop Product Marketing,*
> *Compaq Computer*



Analog Devices' SDK/DDK portfolio and extensive third-party support programs are driving algorithm, application, and driver software development by the industry's finest audio and speech software specialists.



The PSA software architecture links algorithm, application, and system software from independent sources. Open APIs are documented to ensure software compatibility between vendors.

SOFTSOUND TECHNOLOGY: OPPORTUNITY ALL AROUND

Today's competitive market is driving PC hardware vendors to increasingly differentiate products on the back of bundled feature enhancements. But there's a limit to what can be done in hardware without condemning the product to instant obsolescence. Today, software is the key to providing enhanced functionality and flexibility. Software is driving sales.

This emphasis on software functionality is the real power of Signal Computing. Vendors offering new functions and upgrades in software can create general-purpose hardware platforms that retain their value. Software developers, assured of high-volume incremental revenues, will expand the software library, leading more users to the platforms.

"With Analog Devices' chipsets and the Signal Computing program, Dragon Systems' speech technology is becoming routinely available on PC systems."

Janet Baker
President, Dragon Systems

"The DSP model of audio processing, being championed by Analog Devices, follows the microprocessor model. ...open DSP-based audio processing is the right model to follow."

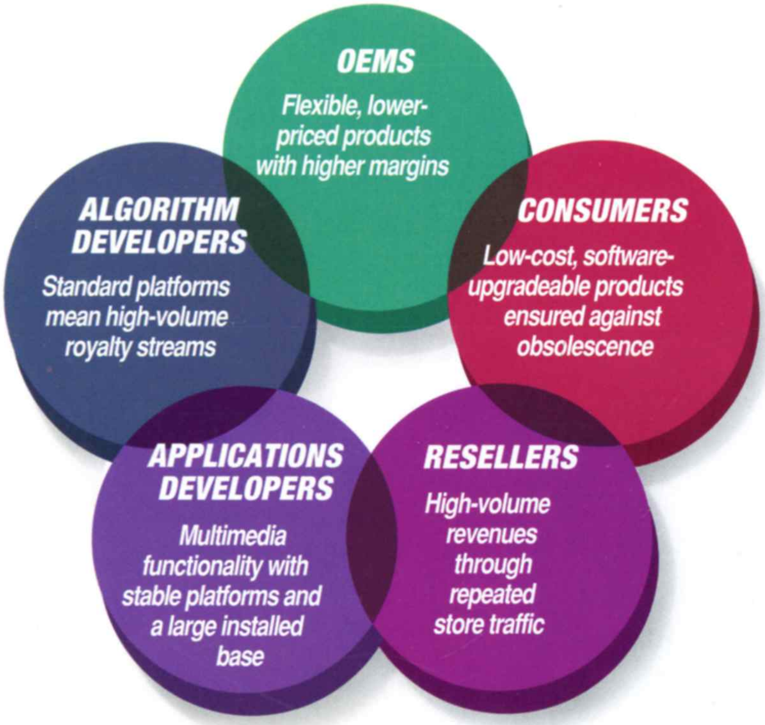
Jim Louderback
PC Week Labs

What is Signal Computing?

The core of the Signal Computing concept is the ability to program an open, multifunction chipset with easily upgraded software. It makes fixed-function PC peripherals obsolete the same way the PC has rendered desktop calculators and word processors relics of the past.

The Signal Computing business model enables non-traditional audio, video, speech, and communications technology providers to embrace PC channel opportunities. It creates flexible, profitable, user-oriented business relationships between players, which accelerates the integration of advanced features into the PC platform.

The technical model delivers software-based products running on open, scalable platforms, superior price/performance, and a growth path to easily migrate solutions as new platforms evolve. Hardware becomes software. Your high-speed modem becomes a $20 software upgrade for your telephony-enabled sound card.


OEMS
Flexible, lower-priced products with higher margins
ALGORITHM DEVELOPERS
Standard platforms mean high-volume royalty streams
CONSUMERS
Low-cost, software-upgradeable products ensured against obsolescence
APPLICATIONS DEVELOPERS
Multimedia functionality with stable platforms and a large installed base
RESELLERS
High-volume revenues through repeated store traffic

The SoftSound approach affords opportunities for all key industry players, including algorithm and software developers, OEMs, resellers, and consumers.

Key sound card features such as General MIDI wavetable synthesis and Dolby AC-2 audio compression come in the form of algorithm software drivers. After-market software products deliver new features and functionality and thereby avoid hardware obsolescence.

THE ROADMAP TO PROFITABILITY

Signal processing algorithm technologies are the weapons of today's sound board wars. Wavetable synthesis techniques obsolete historical OPL-2 and OPL-3 standards. MPEG Layer II and Dolby AC-2 audio compression clearly outperform traditional ADPCM in terms of audio quality. State-of-the-art CELP algorithms deliver eight times higher compressed voice for storage or network transmission.

The programmable PSA decouples such algorithms from the hardware, yielding lucrative opportunities for aggressive players to participate and to profit. No longer will SoundBlaster chipset vendors dictate every sound board's features, leaving manufacturers to clone one feature set.

OEMs may choose to include proprietary algorithm software suites with their product or minimize cost by bundling only baseline algorithms, leaving the rest to after-market channels. The PSA cost structure delivers viable solutions for even the most cost-sensitive channels in the PC industry.

The winners in the '90s are acting today. Manufacturers are partnering with diverse technology companies to establish competitive positions for the key audio, video, and communications technologies that will fuel growth and profitability as PCs move into the home and into your pocket.

HOLD ON FOR THE RIDE!

Most digital signal processing technologies are still in their infancy. Unlike the data processing industry, signal processing has lacked an industry-standard architecture to justify product development. Thanks to the PSA, voice and music quality will improve, audio compression ratios will increase, and your PC will eventually become fluent with multilingual speech recognition and text-to-speech algorithms.

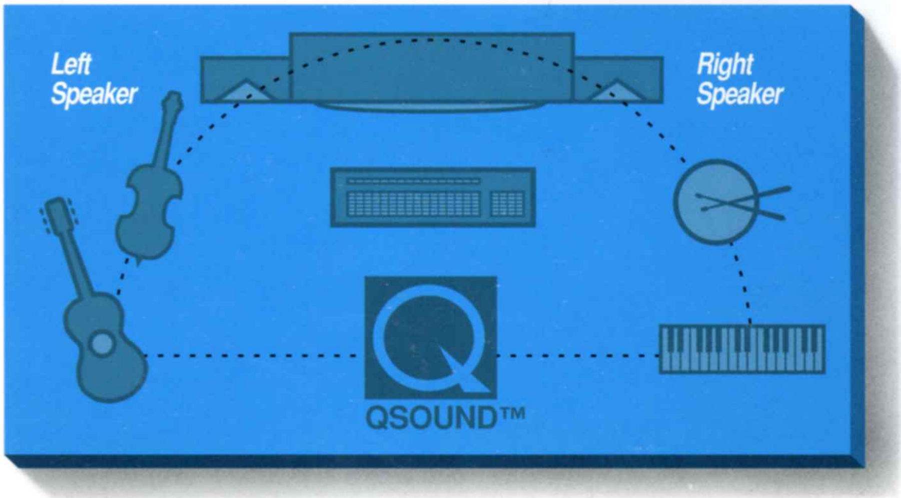
Audio and speech algorithm technology companies are encouraged by the exploding base of PSA-compatible platforms in the field. Like the application developers of the '80s, these entrepreneurial algorithm vendors will continue to add features and end-user value to PSA platforms over the coming decade. And everyone will benefit.

Unlike expensive sound cards or daughter boards, the PSA supports General MIDI wavetable synthesis with a ROM and floppy upgrade—at extremely low cost!

"The DSP-based PSA offers a versatile business and multimedia audio solution. The sound quality of the DSP-based wavetable synthesis offers a superior alternative to the FM synthesis devices used on PC sound cards."

Carmine Bonanno
President, Voyetra Technologies

Using only 2 speakers, the QSound™ algorithm uses psycho-acoustic models to create a 3-D user experience. Audio technology leaders such as Archer/QSound™ find the PSA an ideal mass-market platform for their algorithm software products.



"Analog Devices' Signal Computing chipsets provide price/performance benefits desirable for high-fidelity audio in mass-market applications. We are happy to see Analog Devices support Dolby AC-2."

Steve Forshay
Vice President, Dolby Labs

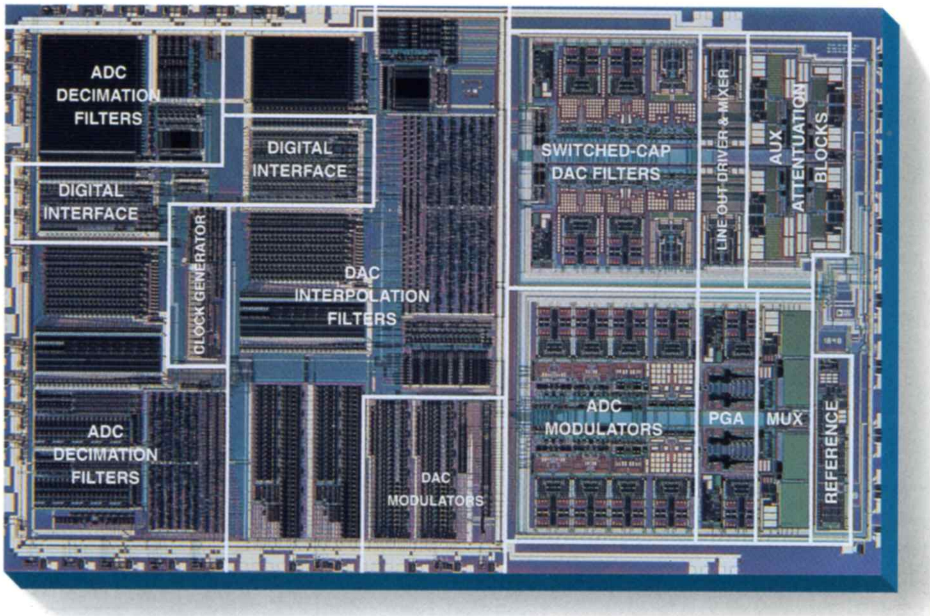
WHERE NEXT?

Analog Devices is aggressively driving the size, cost, and power consumption of PSA solutions to meet the demands of sub-notebook PC platforms by mid 1994. We are the industry leader in mixed-signal VLSI technology, and are uniquely capable of driving the PSA to single-chip integration in the foreseeable future. Subsystem integration is necessary for 16-bit architectures since cost structures are limited by IC packaging technologies, not silicon.

Core processing power will also undergo radical improvements over the coming months. Instruction rates will double from the initial PSA rating of 16 MIPS by the end of 1993. This will translate into superior quality and functionality of core algorithms such as music synthesis, audio compression, and speech recognition.

Portable PC platforms will also drive PSA solutions to 3-V operation with advanced power management for extended battery life. Analog Devices is uniquely positioned to meet the technical challenges of integrating high-performance audio circuitry on the same silicon substrate with digital VLSI within a 3-V environment. We consider this our added value.

Analog Devices is actively partnering with PC design experts to specify next-generation chipsets and single-chip solutions for audio, speech, video, and communications technology integration.

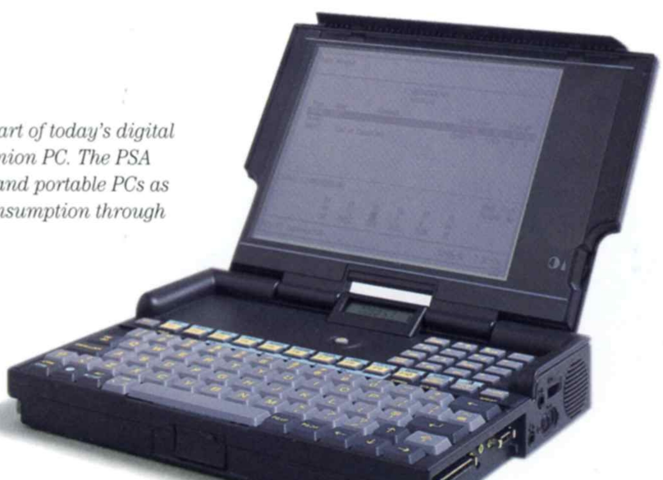


Developed in close collaboration with Compaq Computer and Microsoft, the AD1848 SoundPort combines high-fidelity audio and digital signal processing on one mixed-signal VLSI chip. The device has broken the size, cost, and power threshold for high-quality audio in the mainstream PC industry.

> *"Analog Devices' mixed-signal VLSI technology promises to be the key driver in audio, multimedia, and communications and allows OEMs to provide product differentiation, currently a crying need in the PC industry."*
>
> *Dan Hutcheson, President*
> *VLSI Research*

> *"DSP will enable the melding of computers, communications, and entertainment electronics. Analog Devices' strength in both mixed-signal and DSP technology gives it an edge in many markets."*
>
> *Will Strauss*
> *President, Forward Concepts*

Analog Devices' DSP-based chipsets lie at the heart of today's digital cellular phones and Olivetti's Quaderno companion PC. The PSA will likewise migrate into mainstream desktop and portable PCs as we aggressively reduce size, cost, and power consumption through mixed-signal VLSI integration.



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